Tackling climate change at community level: the example of Geothermal Communities project in Montieri (Italy)

ISBN: 978-84-697-1815-5

Tackling climate change at community level: the example of Geothermal Communities project in Montieri (Italy)

Speakers:
Marino, Valentina[1]

[1] Politecnico di Torino Department of Architecture and Design, Turin, Italy

Abstract: European Union is striving towards energy transition in favour of renewable resources and smart management systems for urban environments. Major cities are generally seen as the main focus of research for implementing innovative solutions, because the environmental problem is more evident there. Local communities, such as small historic towns of Italian territory, demonstrate to have higher potential of success in renewable energy transition than medium and large size Italian cities. This is due to the availability of large amount of natural resources in their territories rarely exploited in a sustainable and organised way.

The paper analyses the main factors characterisng the birth of energy communities at European level and introduces the case study of Geothermal Community project in the Municipality of Montieri to express limits and potentials of undertaking community energy actions in Italian small historic towns.

Community energy, small historic towns, renewable energy resources, local actions

Introduction

By the 20/20/20 European Strategy the European Union has paved the way towards the development of a low carbon society. The European Union is developing specific path for urbanised areas such as the implementation of the Smart City and Communities Stakeholder Platform to achieve social, economic and environmental objectives. Main targets of the platform are European cities and urban communities, where three quarters of European population lives and the 70% of energy consumption and green house gasses emissions occurs. Despite the European interest for cities, several studies demonstrate that the community level is a good scale for implementing renewable energy integration [1] [2] with the aim of tending towards energy autonomy. Isolation of communities is seen as an advantage for implementing 100% renewable energy choices [2]. Literature review demonstrates that the transition to a low carbon society requires a shift from centralised energy system based on fossil fuel resources to a decentralised production and delivery based on a combination of several renewable resources [3] [2]. The scale of the system become fundamental: to approach energy autonomy objective is necessary a balance between demand and supply, the smallest the first the smallest are the investments and the amount of renewable systems to be integrated in the territory. Small-scale actions favour participation of local inhabitants as main stakeholders and managers of their own sustainable development.

ISBN: 978-84-697-1815-5

In Italy small old towns may be the right scale for community energy implementation because of the favourable scale factor represented by low urban density (hence energy demand) and of the potential resources present in their natural territories.

Community energy is the term used to indicate a form of energy management led at community level. It involves citizens as active stakeholders in the multiple areas of energy production, delivery and consumption [4]. In general terms a community is identified by sense of place, identity, localism and shared value. In community energy the term is strictly connected to the local territory and resources availability and how local stakeholders manage it. [2] Community energy represents a local geographic entity with which an actor is potentially associated [5]. Recognised benefits related to local energy projects for generation and distribution of heat and power are mainly the increased security of supply, reduced environmental impact and economic one, derived from the sell of extra power produced [2].

Recent years have seen a successful development of a range of small-scale renewable energy systems (RES) over Europe. A leading country in community shared RES is Denmark where 80% of wind power capacity is owned by local partnerships. The energy policy of Germany is also driving local decision makers to undertake community projects. From Germany are very well documented examples of 100% renewable communities such as the town of Freiamt, that has achieved 100% renewable power generation with a mix of several resources [4], and the action undertaken by the community of Feldheim that has achieved full 100% renewable energy production through measures managed by local farmers and inhabitants.

In Italy the transition towards renewable energy is mainly following the same framework of fossil energy. The general trend is, in fact, the development of large production sites that distribute energy trough existent energy grids. Large power or heat generation plants are installed and companies pay royalties to local administrations for the exploitation of the resource. The mechanism works well for both companies and administrations from economical point of view but due to the large scale, it limits the potential for bottom up actions and energy autonomy of communities. Another phenomenon under development both in Italy and in Europe is that cities are looking at their surrounding territories as reservoirs for renewable energy system installations to satisfy urban energy demand. This represents a threat for landscape preservation of territories because the large energy demand implies extensive installation of RES systems that eventually generate an impact on the natural environment. Nevertheless there are some Italian best practice examples of renewable energy system integrations that take into account local resource potentials and involve local communities. A study promoted by the municipality of Comunità di Castello (Perugia) outlined a potential scenario for energy autonomy of an area of Umbria Region called Alto Tevere Umbro [7]. The analysis demonstrated that a mix of several renewable resources would lead to 100% production of electricity and heating. The energy transition would be able to generate incomes and to attract investors for developing manufactural activities on the area. The scale of intervention should be directly linked with local development favouring small and diffuse plants managed by local communities. An Italian example of best practice is the

ISBN: 978-84-697-1815-5

small town of Varese Ligure that at the end of the 90s started a process of transition towards low carbon energy status through several initiatives that involved different spheres of sustainability. To implement the energy transition that led to the "CO_2-free town" public recognition, the municipality firstly involved a local small medium enterprise (SME) in the installation of two wind turbines. In few years were added other two turbines with the financial support of a bigger company. The power production was also integrated with diffuse photovoltaic arrays and small hydropower units. The municipality with the involvement of local cooperatives installed other RES such as solar thermal systems. The strength of the process was the involvement of local population through awareness campaigns and active participation in local initiatives [8].

In Italy there are few large cities and many medium and small towns. Of the total 8101 municipalities, 5868 are characterised by a population under 5000 inhabitants. [9] A large part of the Italian territory is characterised by hills and mountains and has a quite low density of population distributed in municipalities that own large areas of natural land. Almost all Italian cities and towns have well kept historical centres. Of the total municipalities, 6850 are defined small historic towns. [9] During the second half of the XX century a large part of Italian small towns were subjected to a deep decline. The majority of local population moved towards bigger cities where more services and better job opportunities existed. Also production activities moved towards areas better connected by the main transportation systems. This situation on one side led to abandonment of old urban areas and natural territories with consequences on urban decay and general economic depletion, on the other side it maintained untouched the historic value of settlements, avoiding large urban expansions on the virgin territories. This second factor nowadays may be seen as an advantage in the development of bottom up organisations of resource management. In fact for small historic towns the energy transition towards renewable resources may represent a favourable choice not only for environmental improvements but also for the opportunity of generating local development and jobs and to attract investments.

Methodology

The paper reports the lesson learnt from the experience of the Municipality of Montieri that in 2008 started a process for the exploitation of high temperature geothermal resource present in the territory with the construction of a district-heating network for the town centre. Since 2010 the municipality have taken part in the Geothermal Communities project that integrated initial objectives with solar energy systems and with the management of the energy demand on historic dwellings. The peculiarity of the project is the realisation of a big public work for a small community and the fact that the municipality is a valuable medieval settlement, whose history and survival has always been connected with the resources of the territory. The case study and its results are expressed through the structure of key issues characterising the energy autonomy in sustainable communities proposed by Rae and Bradley in [2], in order to put this local experience in relation to the general European trend in energy community developments.

ISBN: 978-84-697-1815-5

The community of Montieri

The Municipality of Montieri counts 1250 inhabitants on an area of 108.61 km² in the zone of Colline Metallifere in Grosseto province of Tuscany Region. Population density is about 11.5 inhabitants per km². The population is subdivided among four villages: Montieri, the chief town, with its 435 inhabitants and three hamlets, Boccheggiano (498) Gerfalco (139) and Travale (178). There are in total 616 families with an average per household of 2.03 members. The 2001 census (10 years lag) showed a reduction on number of inhabitants by 16.68%. The chief town of Montieri, where the Geothermal Communities project takes place is a small historic village, its urban development begun in medieval time because of the presence of copper and silver mines and its political and economic destiny was always linked to the exploitation of territorial resources.

Project financing

Montieri was one of the last municipalities of the territory that owned a geothermal well and hadn't exploited it yet for thermal energy generation. Among the four hamlets making up the municipality only Montieri can benefit of the geothermal district heating project because of the short distance of the urban centre from the geothermal well. The construction of the district heating has been possible by a combination of public and private funding. Public funding are about 45% of the total cost of the works and are subdivided as follow: national co-financing 46.2%, EU funding 28.59%, municipal funding 10.8% and regional funding 14.42%. Private funding corresponds mainly to the bank loan asked by the municipality that will be pay out mainly by costs that incur for dwelling's connection to the network and first years heating and DHW bills. The initial cost of the service will be high for citizens but will drop as soon as the loan is payed out. ENEL Green Power, the energy group company that in Larderello area manages the geothermal resource for electricity production, yearly pay the royalties to the municipality for the exploitation of the resource that will contribute to reduce the loan as well. European Union funds are provided by the participation as beneficiary member to CONCERTO initiative (FP7) through the Geothermal Communities project (GEOCOM). The project aims at demonstrating the best available technologies in the use of geothermal energy combined with innovative energy efficiency measures and integration of other renewable energy resources in three different European pilot sites located in Hungary, Slovakia and Italy respectively. The Italian project has three main objectives:

- The realisation of a highly innovative, brand new geothermal district heating system network for the historic town centre
- The energy retrofit of selected dwellings among the building estate of Montieri town centre and its three hamlets (Boccheggiano, Gerfalco and Travale)
- Solar renewable systems integration such as 42,5 m² of solar collectors for sanitary hot water production and 8.5 kWp grid connected PV panels

ISBN: 978-84-697-1815-5

The degree and scale of energy autonomy

The geothermal district-heating network is being built in the historic village of Montieri where since fall 2014 will serve 425 dwellings for a total volume of 111000 m^3. The total power installed is about 6100 kW [10]. The district heating will cover the full heating and hot water energy demand of the town centre with renewable geothermal resource. Dwellings will be progressively connected to the network: at October 2014 about 200 units will switch on the system.

The plant is fed by the geothermal steam and from heat recovery from the so-called 'bifase' fluid that is released during power production. Fluids are collected in the circuit of pipeline that connects the geothermal well to the local power plant. The district heating plant is made up of three main closed pipelines that cover a distance of about 5 km and an altitude gap of about 200 mt. The first circuit takes the geothermal fluid from the extraction well's circuit to the heat exchanger A; the second circuit connects the heat exchangers A and B with an insulated pipeline that takes over-heated water for a distance of 2200 mt; a third circuit subdivided into several branches takes the heated water to the dwellings of the city centre. The temperature of the water drops at every step of the circuit. The technical solution implemented represents a cutting edge technology employed for the first time in this sector.

The photovoltaic array foreseen by the Geothermal Communities project will be installed on the roof of the heat exchanger plant A of the district heating system. The location was chosen because of the distance from the historic town and the low visual impact on the landscape. Its size is sufficient to cover part of public lighting energy demand.

Demand side management

Geothermal Communities project required the integration of energy retrofit measures on the built environment in order to reduce global energy demand.

Montieri is a medieval village that still preserves historical characteristics of local old architecture. The town centre is made up of narrow paved streets sided by two/three storey buildings made up of stone and brick masonry. Some very old buildings are recognisable among the urban texture because of stone masonry walls and peculiar arches and openings. Local authority for cultural heritage and landscape listed those buildings as symbols of culture and history of Montieri. In the historic area a relevant portion of buildings needs to be renovated, in some cases critical decay is visible. In order to set suitable energy retrofit measures for old building envelopes a study was developed in [6] with the aim of preserving historical character of fabrics with the implementation of refurbishment measures. The scenario of retrofit intervention defined in [6] reveals that integrating energy efficiency measures tailored on the characteristic of historic buildings can lead to a minimum reduction of total energy demand in the village. The energy saving is estimated as a progression according to the percentage of buildings that undertake retrofit measures: the reduction is

ISBN: 978-84-697-1815-5

about 3%, if just 5% of dwellings undergo renovation works, up to 20% if at least the 30% of buildings is retrofitted.

Social and economic factors

The construction of the geothermal district-heating network was strongly requested by local population because the presence of the geothermal resource has always represented an opportunity for local development since the beginning of XX century. In Larderello area the exploitation of geothermal steam for electricity production started already in 1904 with the lighting up of the first bulbs. The power production started in 1972 as answer to the oil crisis issue. Geothermal energy has always provided local job opportunities as well as economic development for activities and services of the area, otherwise mainly based on agriculture. The towns of the area that benefit from geothermal district heatings from several years, obtained low cost energy bills and very good level of comfort in dwellings. The security of supply and the winter comfort were the major motivations that convinced Montieri's inhabitants towards the development of the district-heating project.

All these factors were crucial for the public acceptance of the investment, of the initial cost and of the inconveniences related to the excavation occurred in the narrow town streets during the construction process. Moreover the installation of the pipeline was the occasion for the renewal of all urban services such as water main, sewer, electricity and other urban grids. The long working phase meant temporary disruption of services and difficulty in the pedestrian mobility, which for a population mainly made up of over 60 age persons may represent a difficulty.

Discussion and conclusion

The experience of the Municipality of Montieri presents some differences from other examples of community renewable energies in Europe. In Montieri the exploitation of the geothermal resource entailed too expensive and cutting-edge technologies to be fund and managed by a bottom up citizens' organisation. The community was involved in the geothermal district-heating project since the very beginning with surveys to assess the common interest, but the design and construction process, due to the financial and technical importance of works, was driven by the local authority through traditional (and complex) public administrative processes. The community was constantly informed of the stages of the process and a specific office was open to deal with private-public issues. The participation of the community increased with Geothermal Communities project in which, in order to implement the final equipments of the network, the dwellings' heat exchangers, citizens autonomously arranged a common purchase group. It can't be stated that local inhabitants own and manage the geothermal resource, nevertheless, if one identifies the community by inhabitants plus local authority, the project can be assumed as a community energy case.

Policies aiming at facilitating community renewable energy should consider prevailing local and institutional conditions. The actors addressed for the implementation may be of various

ISBN: 978-84-697-1815-5

types as well as their interests. [5] This is especially true in the case of Montieri municipality. The project for the construction of a geothermal district heating received wide acceptance by local population even if it included large investments, urban services disruptions and long lasting excavations sites. Motivation of this support is mainly the security of geothermal heat supply and a future reduction of energy bills. The environmental protection and the CO_2 emission's reduction instead are not among motivation factors. This fact explains the low interest that homeowners had towards incentives for energy retrofit measures that were made available by the Geothermal Communities project. In fact a large part of local inhabitants weren't willing to pay for further building works on same dwellings to be connected to the geothermal district heating. According to Parag Y. et al. [3] the implementation of actions depends on both flow of information and financial incentives without a preponderance of one factor on the other. In particular the acceptance of energy efficiency measures for buildings imply a good level of awareness on final consumers of renewable energy. The lack of awareness of local population was also accompanied by the financial difficulties of the municipality that, due to the national norm for regulating local authorities' expenditures (the so called Patto di Stabilità), further limited the public investments on solar resources. This has led to the installation of the photovoltaic system only, leaving the solar thermal project to an uncertain future application.

Rae C. and Bradley F. in [2] state that demand side management is one of the key issues that need to be further explored by research activity, above all about the way it could directly affect energy autonomy in a community and about which would be the related effects on social and economic aspects of actions undertaken. In this sense a further aspect that derives from the lesson learnt of the project in Montieri is that in Italian small historic towns it is necessary to combine actions for improving energy efficiency of building envelopes with general maintenance measures. In fact in small historic towns availability of financial resources for refurbishment and restoration activities is never enough due the number of issues related to old historic building (structural, aesthetic, energetic, etc.). This integration of purposes would lead to face several problems at one time and to implement an overall approach able to enhance not only energy efficiency issues but also the valorization of tangible heritage architecture with positive consequences on economic and touristic sectors too.

References

[1] Doukas ate al., Assessing energy sustainability of rural communities using Principal Components Analysis, renewable energies and sustainable reviews, 16(2012), 1949-1957

[2] Rae C., Bradley F., *Energy autonomy in sustainable communities-A review of key issues*, Renewable and sustainable energy reviews, 16 (2012), 6497-6509

[3] Parag et al., Network approach for local and community governance of energy: the case of Oxfordshire, Energy Policy, 62 (2013), 1064-1077

[4] St. Denis G., Parker p., *Community energy panning in Canada: the role of renewable energy*, Renewable and sustainable energy reviews, 13 (2009), 2088-2095

[5] Wirth S., *Communities matter: Institutional preconditions for community renewable energy*,

ISBN: 978-84-697-1815-5

Energy Policy, 70 (2014), 236-246

[4] Li L.W. et al., *Transition to community-owned renewable energy: lesson from Germany*, Procedia environmental science, 17 (2013), 719-728

[5] Bomberg E., McEwen N., *Mobilizing community energy*, Energy policy, 51(2012), 435-444

[6] Marino V. Energy conscious refurbishment of the village of Montieri. A urban strategy for retrofitting historic architecture, PhD theses, Politecnico di Torino, 2012

[7] Guerrieri M, Schibel K.L., Zara M., *Verso l'autonomia energetica. Il caso dell'Alto Tevere Umbro*, Agenzia fiera delle utopie concrete, Città di Castello

[8] Carrosio G., *Energia, partecipazione e sostenibilità nei piccoli comuni*, in Bulsei G. (edited by), Le sfide della sostenibilità. Risorse ambientali, qualità sociale, partecipazione pubblica, Aracne editrice, 2010, 123-136

[9] Briatore S., *Valorizzazione dei centri storici minori. Strategie di intervento*, Edizioni Diabasis, 2011

[10] www.geothermalcommunities.eu